SOUTH CAROLINA Energy Office

ENERGY BRIEFS

Helping the Homeowner Live Energy Efficiently

Automatic and Programmable Thermostats

In our modern, high-tech society, we don't think much about some of the electronic gadgets in our homes. Take, for example, the ever-present thermostat - a staple of American households for decades. It usually takes the shape of an unassuming box on the wall, but that modest device controls the comfort of your family on the coldest day in January and the hottest day in July.

What Is a Thermostat?

It is a temperature-sensitive switch that controls a space conditioning unit or system, such as a furnace, air conditioner, or both. When the indoor temperature drops below or rises above the thermostat setting, the switch moves to the "on" position, and your furnace or air conditioner runs to warm or cool the house air to the setting you selected for your family's comfort. A thermostat, in its simplest form, must be manually adjusted to change the indoor air temperature.

General Thermostat Operation

You can easily save energy in the winter by setting the thermostat to 68°F (20°C) when you're at home and awake, and lowering it when you're asleep or away. This strategy is effective and inexpensive if you are willing to adjust the thermostat by hand and wake up in a chilly house. In the summer, you can follow the same strategy with central air conditioning, too, by keeping your house warmer than normal when you are away, and lowering the thermostat setting to 78°F (26°C) only when you are at home and need cooling.

A common misconception associated with thermostats is that a furnace works harder than normal to warm the space back to a comfortable temperature after the thermostat has been set back, resulting in little or no savings.

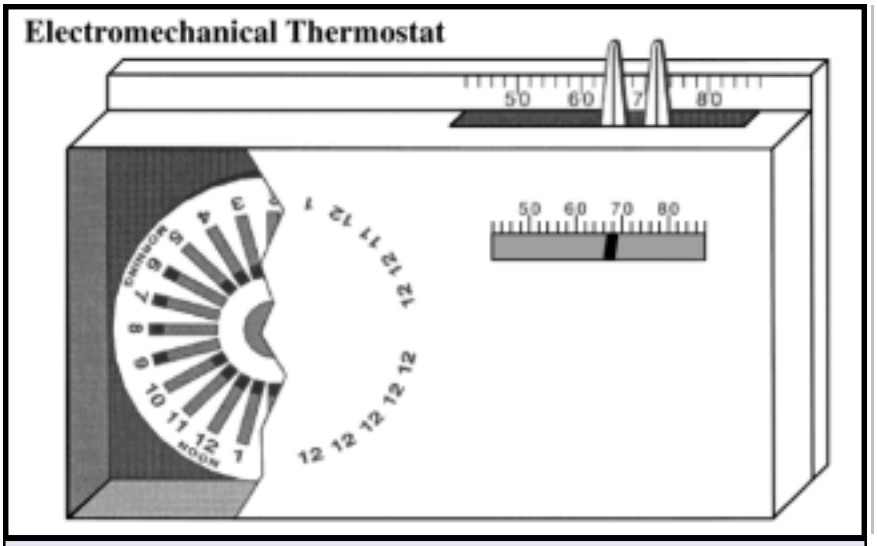
This misconception has been dispelled by years of research and numerous studies. The fuel required to reheat a building to a comfortable temperature is roughly equal tothe fuel saved as the building drops to the lower temperature.You save fuel between the time that the temperature stabilizes at the lower level and the next time heat is needed. So, the longer your house remains at the lower temperature, the more energy you save.

Another misconception is that the higher you raise a thermostat, the more heat the furnace will put out, or that the house will warm up faster if the thermostat is raised higher. Furnaces put out the same amount of heat no matter how high the thermostat is set—the variable is how long it must stay on to reach the set temperature.

In the winter, significant savings can be obtained by manually or automatically lowering your thermostat's temperature setting for as little as four hours per day. These savings can be attributed to a building's heat loss in the winter, which depends greatly on the difference between the inside and outside temperatures. For example, if you set the temperature back on your thermostat for an entire night, your energy savings will be substantial. By turning your thermostat back 10° to 15° for 8 hours, you can save about 5% to 15% a year on your heating bill—a savings of as much as 1% for each degree if the setback period is eight hours long. The percentage of savings from setback is greater for buildings in mild climates such as South Carolina's than for those in more severe climates.

In the summer, you can achieve similar savings by keeping the indoor temperature a bit higher when you're away than you do when you're at home.

But there is a certain amount of inconvenience that results from manually controlling the temperature on your thermostat. This includes waking up in a cooler than normal house in the winter and possibly forgetting to adjust the thermostat (during any season) when you leave the house or go to bed.



Electromechanical thermostats have internal programming wheels that track the time of day and night. Pins or tabs in the wheel trigger the heating or cooling system to start or shut off.

Thermostats with Automatic Temperature Adjustment

To maximize your energy savings without sacrificing comfort, you can install an automatic setback or programmable thermostat. They adjust the temperature setting for you. While you might forget to turn down the heat before you leave for work in the morning, a programmable thermostat won't! By maintaining the highest or lowest required temperatures for four or five hours a day instead of 24 hours, a programmable thermostat can pay for itself in energy saved within four years.

Programmable thermostats have features with which you may be unfamiliar. The newest generation of residential thermostat technologies is based on microprocessors and thermistor sensors. Most of these programmable thermostats perform one or more of the following energy control functions:

*They store and repeat multiple daily settings, which you can manually override without affecting the rest of the daily or weekly program.

*They store six or more temperature settings a day.

*They adjust heating or air conditioning turn-on times as the outside temperature changes.

Most programmable thermostats have liquid crystal temperature displays. Some have back-up battery packs that eliminate the need to reprogram the time or clock in case of a power failure. New programmable thermostats can be programmed to accommodate life style and control heating and cooling systems as needed.

Types of Automatic and Programmable Thermostats

There are five basic types of automatic and programmable thermostats:

*Electromechanical

*Digital *Hybrid

*Occupancy *Light Sensing

Most range in price from $30 to $100, except for occupancy and light sensing thermostats, which cost around $200.

Electromechanical (EM) thermostats, usually the easiest devices to operate, typically have manual controls such as movable tabs to set a rotary timer and sliding levers for night and day temperature settings. These thermostats work with most conventional heating and cooling systems, except heat pumps. EM controls have limited flexibility and can store only the same settings for each day, although at least one manufacturer has a model with separate settings for each day of the week. EM thermostats are best suited for people with regular schedules.

Digital thermostats are identified by their LED or LCD digital readout and data entry pads or buttons. They offer the widest range of features and flexibility, and digital thermostats can be used with most heating and cooling systems. They provide precise temperature control, and they permit custom scheduling. Programming some models can be fairly

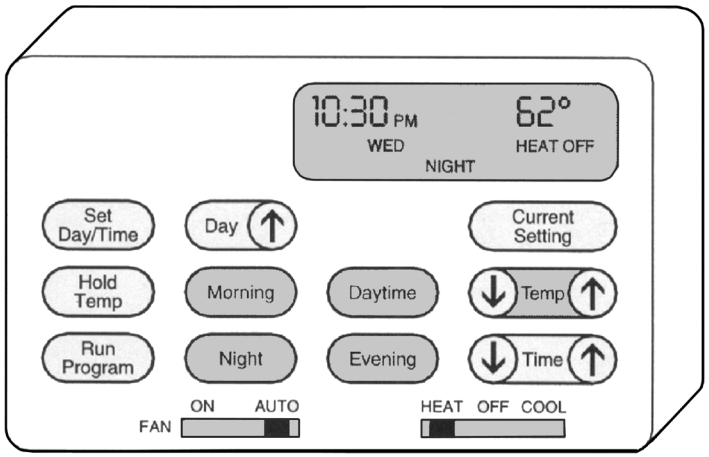
complicated; make sure you are comfortable with the functions and operation of the thermostat you choose. Remember— you won't save energy if you don't set the controls or you set them incorrectly.

Hybrid systems combine the technology of digital controls with manual slides and knobs to simplify use and maintain flexibility. Hybrid models are available for most systems, including heat pumps.

Occupancy thermostats maintain the setback temperature until someone presses a button to call for heating or cooling. They do not rely on the time of day. The ensuing preset "comfort period" lasts from 30 minutes to 12 hours, depending on how you've set the thermostat. Then, the temperature returns to the setback level. These units offer the ultimate in simplicity, but lack flexibility. Occupancy thermostats are best suited for spaces that remain unoccupied for long periods of time.

Light Sensing heat thermostats rely on the lighting level preset by the owner to activate heating systems. When lighting is reduced, a photocell inside the thermostat senses unoccupied conditions and allows space temperatures to fall 10° below the occupied temperature setting. When lighting levels increase to normal, temperatures automatically adjust to comfort conditions. These units do not require batteries or programming and reset themselves after power failures. Light sensing thermostats are designed primarily for stores and offices where occupancy determines lighting requirements, and therefore heating requirements.

Digital Thermostat



Digital thermostats are programmed with electronic keys or buttons, and many can be programmed with different schedules for weekdays and weekends.

A Note for Heat Pump Owners

When an electric heat pump is in its heating mode, setting back a conventional heat pump thermostat can cause the unit to operate inefficiently, thereby canceling out any savings achieved by lowering the temperature setting. Maintaining a moderate setting is the most cost-effective practice. Recently, however, some companies have begun selling specially designed setback thermostats for heat pumps, which make setting back the thermostat cost effective. In its cooling mode, the heat pump operates like an air conditioner; therefore, manually turning up the thermostat will save you money.

Choosing a Programmable Thermostat

When shopping for a thermostat, bring information with you about your current heating and air conditioning unit, including the brand and model number. Also, ask these questions before buying a thermostat:

* Does the unit's clock draw its power from the heating systems's low-voltage electrical control circuit instead of a battery? If so, is the clock disrupted when the furnace cycles on and off? Battery-operated back-up thermostats are preferredby many homeowners. Is the thermostat compatible with the electrical wiring found in your current unit?

* Are you able to install it yourself, or should you hire an electrician or a heating, ventilation, and air conditioning (HVAC) contractor?

* How precise is the thermostat?

* Are the programming instructions easy to understand and remember? Some thermostats have the instructions printed on the cover or inside the housing box; otherwise, you will have to consult the instruction booklet every time you want to change the setback times.

Most automatic and programmable thermostats completely replace existing units. These are preferred by many homeowners. However, some devices can be placed over existing thermostats and are mechanically controlled to permit automatic setbacks. These units are usually powered by batteries, which eliminates the need for electrical wiring. They tend to be easy to program, and because they run on batteries, the clocks do not lose time during power outages.

Before you buy a programmable thermostat, chart your weekly habits including wake up and departure times, return home times, and bedtimes, and the temperatures that are comfortable during those times. This will help you decide what type of thermostat will best serve your needs.

Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.
6:00 am	6:00 am	6:00 am	6:00 am	6:00 am	8:00 am	8:00 am
68 F	68 F	68 F	68 F	68 F	68 F	68 F
7:30 am	7:30 am	7:30 am	7:30 am	7:30 am	--	--
60 F	60 F	60 F	60 F	60 F	--	--
5:00 pm	5:00 pm	5:00 pm	5:00 pm	5:00 pm	--	--
68 F	68 F	68 F	68 F	68 F	--	--
10:00 pm	10:00 pm	10:00 pm	10:00 pm	10:00 pm	10:30 pm	10:30 pm
62 F	62 F	62 F	62 F	62 F	62 F	62 F

Other Considerations

The location of your thermostat can affect its performance and efficiency. Read the manufacturer's installation instructions to prevent "ghost readings" or unnecessary furnace or air conditioner cycling. Place thermostats away from direct sunlight, drafts, doorways, skylights, and windows. Also make sure your thermostat is conveniently located for programming.

Some modern heating and cooling systems require special controls. Heat pumps are the most common and usually require special setback thermostats. These thermostats typically use special algorithms to minimize the use of backup electric resistance heat systems. Electric resistance systems, such as electric baseboard heating, also require thermostats capable of directly controlling 120 volt or 240 volt line-voltage circuits. Only a few companies manufacture line-voltage setback thermostats.

A Simpler Way to Control Your Environment

The best thermostat for you will depend on your life style and comfort level in varying house temperatures. While automatic and programmable thermostats save energy, a manual unit can be equally effective if you diligently regulate its setting—and if you don't mind a chilly house on winter mornings. If you decide to choose an automatic thermostat, you can set it to raise the temperature before you wake up and spare you some discomfort. It will also perform consistently and dependably to keep your house at comfortable temperatures during the summer heat, as well.

Source List

The Energy Efficiency and Renewable Energy Clearinghouse (EREC):
P.O. Box 3048
Merrifield, VA 22116
(800) 363-3732
Fax: (703) 893-0400
E-mail: doe.erec@nciinc.com
www.eren.doe.gov/erec/factsheets/factsheets.html

South Carolina Energy Office
1201 Main Street, Suite 820
Columbia, SC 29201
(803)737-8030
(800) 851-8899
Fax (803) 737-9846
http://www.state.sc.us/energy/

EREC and the SC Energy Office provide free general and technical information to the public on the many topics and technologies pertaining to energy efficiency and renewable energy.

Reading List

"Energy Saving Thermostats," Consumer Reports, October 1993.
"Home Q&A," Home Mechanix, November 1995.
"Smart Thermostats for Comfort and Conservation," March 1994, EPRI Journal.

This document was produced for the U.S. Department of Energy (DOE) by the National Renewable Energy Laboratory (NREL), a DOE national laboratory. The document was produced by the Information Services Program, under the DOE Office of Energy Efficiency and Renewable Energy. The Energy Efficiency and Renewable Energy Clearinghouse (EREC) is operated by NCI Information Systems, Inc., for NREL/DOE. The statements contained herein are based on information known to EREC and NREL at the time of printing. No recommendation or endorsement of any product or service is implied if mentioned by EREC.